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Contrast enhanced ultrasonography versus MR angiography in aortocaval fistula: case report

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Abstract

Aortocaval fistula (ACF) is a rare, life threatening complication of abdominal aortic aneurysms. Time to diagnosis is crucial as preoperative diagnosis and early surgical intervention significantly improve the outcome. The clinical spectrum being varied, the challenge of prompt and reliable diagnosis rests on emergency radiology. While the gold standard for detecting ACF today is CT angiography (CTA), frequently complicating renal insufficiency discourages the use of iodinated contrast making MR angiography (MRA) a useful alternative. Contrast enhanced ultrasound (CEUS) provides a promising new diagnostic option allowing rapid, non invasive and bedside diagnosis, especially in hemodynamically unstable patients. We present a case of prompt diagnosis of ACF by CEUS in comparison to modern MRA, thus establishing the new potential role of CEUS.

Key words: Aortocaval fistula—Contrast enhanced ultrasound—Magnetic resonance angiography—CT angiography—Emergency radiology

Introduction

Aortocaval fistula is a rare, life threatening clinical emergency with a mortality ranging from 16% to 66% [1–4]. Prompt surgical treatment is critical with a two-thirds reduction in operative mortality rates if the diagnosis is known preoperatively [3].

Since the classically described presentation triad of acute abdominal pain, pulsatile abdominal mass, and an audible machinery-like bruit may be absent in up to 50% of these patients, imaging thus plays a crucial role in the diagnosis [3].

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Recent technical developments in contrast-specific low mechanical index real-time gray-scale imaging use images based on non linear acoustic interaction between the ultrasound system and stabilized microbubbles. SonoVue (Bracco, Milan) is a second-generation contrast agent consisting of stabilized microbubbles of sulfur hexafluoride gas. It is of low solubility, innocuous, isotonic with human plasma, and devoid of antigenic potential [5, 6].

The gold standard for detecting and characterizing an aortocaval fistula today is computed tomographic angiography (CTA) [7]. However, frequently complicating renal insufficiency seen in 11.8–33% of these patients discourages the use of iodinated contrast, making magnetic resonance angiography (MRA) a useful alternative [8, 9]. In this case report, we describe our experience of prompt diagnosis of an abdominal aortic aneurysm complicated by an aortocaval fistula by bedside acquisition of contrast enhanced ultrasound (CEUS) in comparison to modern MRA.

Case report

A 74-year-old patient with a previous history of renal calculi presented to the emergency department with lumbar pain and renal insufficiency. The patient was known to have hypertension, hypercholesterolemia, and ischemic heart disease. On physical examination, the patient was stable with no undue findings on abdominal auscultation. With a working diagnosis of renal colic an ultrasound examination was requested.

A bedside ultrasound examination with color and Doppler examinations was performed using a 3.5 MHz convex transducer and an Aloka Prosound 5000 SV mobile unit. The study depicted a 9 cm diameter infrarenal abdominal aortic aneurysm with a 3-cm eccentric intraluminal thrombus (Fig. 1). The adjacent inferior vena cava (IVC) was compressed and aliasing was noted between the abdominal aorta and the inferior vena cava.

Fig. 1. Grey scale ultrasonography: Aneurysmal dilation of the abdominal aorta (Ao) with an eccentric luminal thrombus (asterisk).

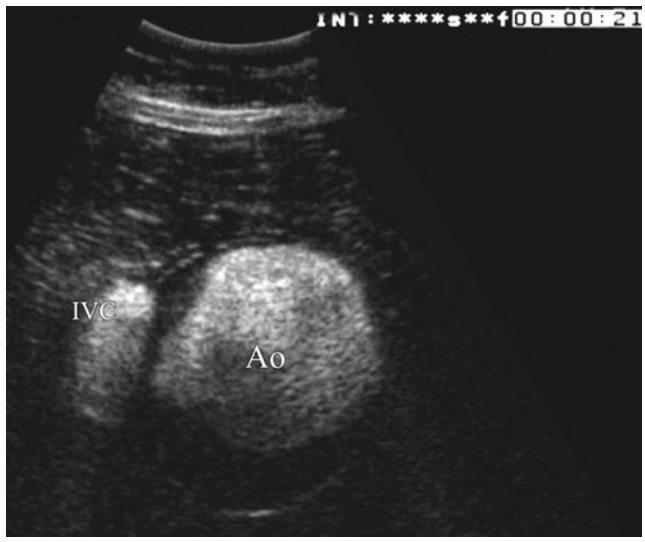

Fig. 2. Contrast-enhanced low mechanical index ultrasonography 21 seconds following intravenous injection of Sonovue: Concomitant enhancement of the aortic aneurysm (Ao) and inferior vena cava (IVC).

Fig. 3. Contrast-enhanced ultrasonography: Demonstration of a fistulous tract (arrow) between the aorta (Ao) and the inferior vena cava (IVC).

In order to better characterize the nature of vascular derangements at this level, a decision to perform a CEUS study was made.

The CEUS was performed using real time harmonic imaging with continuous low acoustic power setting (Mechanical-index between 0.1 and 0.2) on the Aloka Prosound 5000SV System at the patient's bedside. A 2.4 ml bolus injection of Sonovue was rapidly injected into the antecubital vein through a 20 G catheter followed by a 10 ml saline flush.

The entire abdominal aorta was scanned continuously in longitudinal and transverse planes for 5 min. Twenty-one seconds after the injection, early synchronous, homogenous and concomitant opacification of the aorta and the inferior vena cava was noticed (Fig. 2), with a 3-cm long and 1-cm wide continuous tract of contrast between the aneurysm and the inferior vena cava, notably a direct sign of an aortocaval fistula (Fig. 3). An accessory sign of attenuated vascularity in the kidneys was seen, corroborating with the existing renal insufficiency.

The rarity of the condition, relative lack of experience in contrast enhanced ultrasound in aortocaval fistula, stable condition of the patient, and presence of renal insufficiency (Creatinine level of 316 μmol/L) made the clinicians reluctant to pursue a CT angiography. The surgical team requested for preoperative mapping of the aortocaval fistula by an MRA (Fig. 4). Gadolinium-enhanced 3D MR angiography was acquired (Magnetom Espree, Siemens Medical Systems, Erlangen, Germany) with 30 cc intravenous Dotarem injection. A fat-suppressed sequential 3D fast low-angle-shot pulse sequence with the following parameters: TR:3 ms; TE:1 ms; flip angle: 30°; matrix: 384 × 384 was acquired. MRA displayed a polylobulated infrarenal abdominal aortic

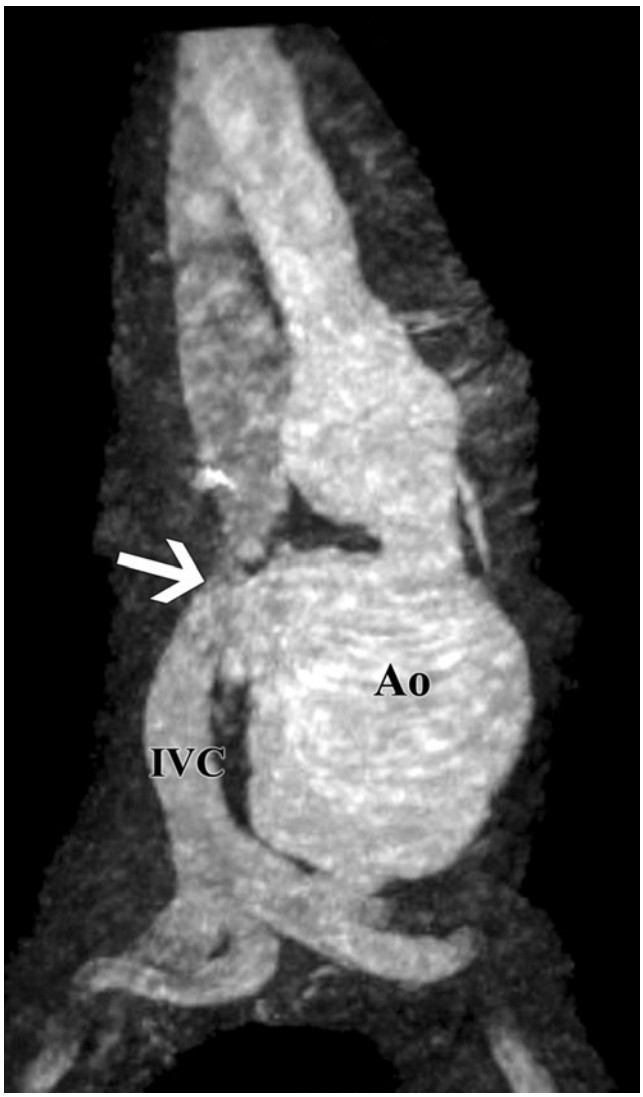

Fig. 4. 3D MR angiographic reconstruction image: Demonstrating an infrarenal aortic aneurysm (Ao) displacing and compressing the adjacent inferior vena cava (IVC) with a fistulous direct communication between the aneurysm and the IVC (arrow).

aneurysm, with displacement and compression of the adjacent IVC (Fig. 4) communicating with the same by a 1-cm thick channel, thus confirming the diagnosis of aortocaval fistula.

Immediate emergency surgery was planned. However, the patient deteriorated rapidly due to cardiac complications and died prior to surgery from myocardial infarction.

Discussion

Aortocaval fistula was first described by Syme in 1831 in a 22-year-old man with syphilitic aortitis and aneurysm [10]. Spontaneous aortocaval fistula is a rare complication that involves less than 1% of all abdominal aortic aneurysms and 3–4% of ruptured abdominal aneurysms [3, 4].

While most of these aneurysms are atherosclerotic in nature, aortocaval fistulas have rarely been seen in association with inflammatory, leutic, mycotic aneurysms, aneurysm-forming conditions such as Marfan's, Ehlers-Danlos syndrome, Takayasu's arteritis, neoplastic erosion from an adjacent malignancy, trauma and finally iatrogenic causes as lumbar disk surgery or cardiac catheterization [1–3]. The vast majority of affected patients reported are men in their seventh and eighth decades of life [11], as was our patient. The clinical presentation is variable and depends on the fistula size and location. A small fistulous orifice may be almost asymptomatic, whereas a large fistula presents with hemodynamic derangements of a large volume left-to-right shunt [2, 3]. This causes increased venous return leading to venous hypertension, passive venous congestion, hepatomegaly, ascites, and portal hypertension [2, 3].

Caval compression from the arterial aneurysm often hampers venous return with marked regional venous hypertension [2, 3]. Renal failure is not uncommon and was prominent in our patient's presentation. The decreased peripheral resistance may induce a sharp secondary increased cardiac output and left ventricular high output cardiac failure [2], which was a prominent cause of our patient's deteriorating cardiac status. Finally, paradoxical pulmonary embolus originating within the aneurysmal sac may migrate into the vena cava [2, 3].

The diagnosis of aortocaval fistula is not difficult when the classical triad of severe low back or abdominal pain, pulsatile abdominal mass, and a machinery like abdominal bruit or thrill are present [3]. However in up to 50% of these patients, this reliable clinical presentation may be absent. In our patient, also the predominant symptom was a right flank pain with renal insufficiency misguiding the diagnosis towards a renal origin.

A quick diagnosis is nevertheless crucial as surgical outcome is heavily influenced by the extent and duration of the preoperative hemodynamics and delayed surgery carries lower survival [2, 3, 9]. Operative mortality rates after repair of an aortocaval fistula range from 20% to 55%, with a two-thirds reduction if the diagnosis is known preoperatively [3].

Although the gold standard for detecting and characterizing aortocaval fistula today is CTA [12] and vascular ultrasound is often regarded as a second choice modality, many authors agree that subjects with typical symptoms should not undergo prolonged investigations and that urgent sonography should be the initial diagnostic step [9, 13].

Today, the ultrasound technology offers promising developments. Low-mechanical index technology allows the non destructive stimulation of second-generation sonographic contrast agents while continuously scanning

to produce real time contrast enhanced gray-scale images [9, 12]. Further the procedure does not require dedicated patient or contrast preparation. The contrast agent SonoVue can be prepared in a few seconds and can be administered immediately. The time needed for baseline and contrast-enhanced sonography in our study was 5 min, which was less than the 20 min taken to acquire the MRA.

In our study, the contrast-enhanced sonography was comparable to MRA and gave sufficient information regarding the size and localization of the aortocaval fistula. A well-demarcated tract of sonographic contrast medium was seen as a pulsatile hyperechoic jet through the mural thrombosis with concomitant enhancement of the IVC. This appearance allowed rapid and bedside diagnosis of the aortocaval fistula despite the misleading clinical presentation [9].

In routine clinical practice, ultrasound is frequently the first modality of choice for imaging a patient arriving in the emergency with non specific abdominal pain and renal insufficiency. The clinician may be particularly reluctant to perform a contrast enhanced CT particularly in the absence of even a diagnosis of aortic aneurysm. On the depiction of an abdominal aortic aneurysm by ultrasonography, a following CEUS is recommended to further characterize the abdominal aortic aneurysm and to assess for the possible complication of aortocaval fistula, a situation, which warrants urgent intervention. The bedside examination that is possible with contrast enhanced ultrasound, in particular, for hemodynamically compromised patients having abdominal aortic aneurysm provides a good alternative to MRA or CTA as these modalities have the limitations of crucial time spent for patient transportation and scan acquisition, particularly in the context of an unstable patient, which may interfere with the work of the resuscitative team [12].

Ultrasound contrast agents seem to substantially increase ultrasound diagnostic accuracy [14]. Nonetheless, CEUS has some limitations. Obesity and bowel gas can interfere with ultrasound scanning. The equipment including the contrast agent is highly specific, not yet widely available and expensive. The examination is operator dependent and requires specific skills and training. Another disadvantage is that it cannot cover all aspects of the aorta such as the thoracic aorta and thus may underestimate the true extent of the aortic aneurysm. However, owing to its wide availability, safety and low cost, sonography is used with increasing worldwide popularity for rapid screening for abdominal aortic aneurysm [15].

Our case represents a comparison of CEUS and MRA in an aortocaval fistula. We believe that CEUS can provide a quick, reliable, and bedside complement to routine ultrasound studies in an emergency setting when a diagnosis of abdominal aortic aneurysm is made. Since even stable patients with aortocaval fistula can deteriorate rapidly [9], performing the contrast enhanced ultrasound study in the emergency department without a follow-up CTA or MRA examination could significantly shorten the presurgical time and have positive impact on patient outcome. Other researchers have already argued similar findings with respect to CT where despite the information given on CT, how this detailed data affects emergency treatment and prognosis [9]. There is thus a need to progressively obtain the surgeons' trust in basing the diagnosis of aortocaval fistula on contrast enhanced sonographic findings without confirmatory second-level imaging, which could have a crucial bearing on the morbidity and mortality of the patient.

Conclusion

Contrast enhanced ultrasound with Sonovue is a new, safe, time effective, rapid, relatively non invasive, dynamic-, and real-time imaging tool in the detection of aortocaval fistula with accurate and good correlation with MRA. The main advantage is its bedside availability, which is particularly important in the emergency settings of hemodynamically compromised patients for preoperative analysis thus reducing the time to surgery. It thus provides an excellent complement to the preliminary ultrasound study when an abdominal aortic aneurysm is depicted during an emergency ultrasound for non specific abdominal pain, as it precludes the need for further imaging by CTA or MRA.

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